BOOK OF ABSTRACTS **Open Access**

The reliability and validity of the 3-minute critical power test

J Wright [1]✉, S Jobson[2], and S Bruce-Low[1]

Abstract

Background: Athletes utilise exercise testing to assist with training design and race strategy. Critical power (CP) is a useful addition to an exercise testing battery as it provides an estimate of the heavy-severe exercise domain boundary (Vanhatalo et al., 2007: Medicine & Science in Sports & Exercise, 39(3), 548-55). Although the benefits of calculating CP are known, the traditional CP test protocol is excessively time consuming. Studies have suggested that CP can be obtained from a single 3-minute bout of 'all-out' exercise using the Lode Excalibur Sport cycle ergometer in linear mode (Vanhatalo et al., 2008: Medicine & Science in Sports & Exercise, 40(9), 1693-9). A more recent study (Karsten et al., 2013: International Journal of Sports Medicine, 35(4), 304-9) suggests that the 3-minute test does not provide a valid measure of critical power when using the SRM cycle ergometer in isokinetic mode.

Purpose: To investigate the reliability and validity of the 3-minute critical power test in both isokinetic and linear modes using the Lode Excalibur Sport.

Methods: Six male cyclists (mean ± SD; age 33 ± 7.7 yr, body mass 83.42 ± 9.9 kg, maximum aerobic power (MAP) 343 ± 50 W, $\dot{V}O_{2max}$ 4.38 ± 0.77 L·min^{-1}) gave written informed consent to participate in the study, which was approved by Southampton Solent University's ethics committee. Each participant took part in 8 trials, each separated by a minimum of 48 hours. The first trial took part in two stages. The first was an incremental step test (100 W start with 25 W increments every 3 minutes) to calculate gas exchange threshold (GET). The second stage was a ramp test (100 W start with 20 W·min^{-1} increments) to calculate MAP and $\dot{V}O_{2max}$. During trials 2–4, each participant completed three efforts to exhaustion (80, 100 and 105% MAP). The results from these trials were used to calculate critical power, which included both the 1/time (CP1) and work–time (CP2) critical power models. Traditionally, these models have both been used to calculate CP. The final four trials were used to estimate critical power from two separate 3-minute protocols. Two trials were carried out using the linear mode following the protocol described by Vanhatalo et al. (2008). The two remaining trials were carried out in the isokinetic mode at the participant's preferred cadence following the protocol described by Karsten et al. (2013). Apart from trial one, all testing sessions were carried out in a randomized order. A repeated measures ANOVA was used to compare CP and End Power (EP) with significance set at $p<0.05$. Coefficient of variation was used to compare EP-isokinetic and EP-linear between each testing session. For reliability to be seen in sports science testing it has been suggested that a CV of less than 5% is required (Hopkins, 2000: A new view on statistics. Retrieved 31 March 2014, from http://www.sportsci.org/resource/stats).

Results: There was no significant difference between EP-isokinetic and CP1 (+2.6 W, p=0.80) or between EP-isokinetic and CP2 (+5.1 W, p=0.46). There were significant differences between EP-linear and CP1 (+31.5 W, p=0.01) and between EP-linear and CP2 (+39.2 W, p=0.02). Coefficient of variation in EP-isokinetic and EP-linear was 3.35% and 1.15%, respectively. Discussion: To the authors' knowledge this is the first time that the linear and isokinetic modes have been evaluated in a single cohort. The results suggest that the 3-minute isokinetic test provides a reliable measure of EP and a valid measure of CP. Although the 3-minute linear test seems to provide a reliable measure of EP, these results suggest that it does not provide a valid measure of CP. Therefore, the results from this pilot study do not fully support previous literature (Vanhatalo et al., 2008; Karsten et al., 2013).

Conclusion: This study provides preliminary evidence to suggest that the 3-minute isokinetic testing protocol can be used to estimate the heavy-severe exercise domain boundary.

✉**Contact email:** *simon.jobson@winchester.ac.uk* (S. Jobson)

[1]Health, Exercise and Sport Science, Southampton Solent University, United kingdom

[2] Department of Sports Studies, University of Winchester, United Kingdom

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